A New Haptic Interaction Paradigm

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Abstract
Existing tactile experiences are limited to providing feedback or conveying pattern information to the user. In this position paper, we discuss how mid-air haptics are uniquely suited to explore wholly independent haptic interaction paradigms which allow the user to interact with a computer completely using her tactile and kinesthetic sense without the presence of a visual interface.

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Haptics; Tactile; Interaction;

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H.5.2 [Information interfaces and presentation]: User Interfaces - Haptic I/O

Introduction
Current haptic technologies have enabled advanced user experiences. However, these experiences almost always function as haptic patterns to convey infomrmation to the user or as assistive feedback to a visual interface.Engaging with visual displays is not always feasible or desired. At this stage of haptics, an exploration is needed into the possibilities of a wholly independent haptic interaction paradigm which allows the user to interact with a computer completely using her tactile and kinesthetic sense without the presence of a visual interface. While one could argue that

such independent interactions exist in bits and pieces, an interaction paradigm akin to direct manipulation in visual displays is missing in haptic displays. Owing to its unique affordances, mid-air ultrasound haptics could be uniquely suited to explore such interaction paradigms.

Exploration into a Haptic Interaction Paradigm

The concept of direct manipulaton underlies almost all of the visual interfaces we use today. These could be indirect pointing interfaces that utilize a pointer to manipulate objects, or direct pointing interfaces that allow the user to manipulate these objects directly via touch or other means. A notion analogous to direct manipulation is absent in haptic displays. One of our upcoming papers in CHI 2016 [2] raises this issue and introduces the concept of direct manipulation for tactile displays that are instrumented on the skin. We describe how concepts analogous to a visual display can be adapted into a tactile context, such as a tactile screen, tactile pixel, tactile pointer, and tactile targets. However, there are a lot of open questions.

There are multiple facets to such interaction paradigms that need exploration: tactile vs haptic displays, 1D vs 2D vs 3D displays, direct pointing vs indirect pointing vs something completely novel, and different body and skin regions and their unique constraints. Looking at its demonstrated capabilities, mid-air haptics can potentially address a lot of these questions. It actuates multi-point mid-air haptic sensations with users being able to distinguish different properties of points at small separations [1]. Such multiplicity of points will be useful when defining a haptic interface model. Further, perception studies have shown high resolution localization and apparent motion capabilities [6]. Plus, continuous 3D and volumetric haptic shapes have been rendered in mid-air using ultrasound [3]. All these works plus interaction works that have demonstrated ultrasonic widgets [5] and mid-air haptic interaction with floating screens [4] all encourage us to think that an end-to-end haptic interaction paradigm would not only be feasible, but easily implentable and usable too with the use of mid-air haptics.

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